

LS- 160

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## APS STORAGE RING VACUUM CHAMBER TESTS FOR DIMENSIONAL STABILITY

### AFTER BAKEOUT CYCLING WHILE UNDER VACUUM

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### INTRODUCTION

Vacuum chamber sections #1 and #2 were used for these tests. Section #1, a short straight section, is representative in these tests of Sections #3 and #5 as well. Section #2 is the longer curved section used within the dipole bend magnets and is representative of the similar Section #4. The combination of Sections #1 and #2 joined by a connecting bellows was mounted as presently planned for the final installation. This afforded an early testing of chamber positional stability after bakeout cycling. Tests of chamber dimensional stability were also made during vacuum cycling.

### TEST SETUP

Figure 1 shows a plan view of the test setup. The #1 and #2 sections are of an earlier 26.5 m sector design. The sections were actually mounted upside down to accommodate certain pump mountings on Section #1 used in earlier vacuum tests. Support locations were located close to the original design.

Optical survey targets were placed on the chambers in seven locations indicated as T-1 through and including T-7. Two lines of sight were used to locate the chamber targets, one for location in the x direction (indicated as "T" readings) across the chamber width and the other for location in the z direction (indicated as "P" readings) along the chamber length.

The "T" readings were made by moving one survey scope along a tooling bar. The "P" readings were made by six individual survey scopes, each mounted in one set position throughout the tests.

In addition to optical sighting, five dial indicators were used in the area of some "T" targets for check of x direction changes. A sixth dial indicator was used to check chamber elevation movements (y-direction) in the area of a leaf spring type support.

Tests were also conducted to monitor changes in the positron beam chamber height and light gap opening dimensions during vacuum cycling. Nine "C" locations along the two sections close to the "T" locations were monitored.

## **RESULTS**

### **STABILITY TESTS OF CHAMBERS DURING BAKEOUT CYCLING**

Test cycles were made of the bakeout of the chambers from room temperature to 150 ° C and back to room temperature. It was found that the chambers had become loose from their support mounts during the first nine cycles and this condition accounted for deviations of as much as 0.012" in T-7 during cycle #9. The loose condition was solved by using Belleville spring washers in the support clamp bolting. Table 1 shows resultant variances during cycles #14 to #25. The variances are normalized to cycle #13. Most variances were within (plus or minus) 0.003". There are a few within 0.004". The "P" measurements along the length of the chambers were within 0.002" total. Further tests will be made on a full sector.

### **CHAMBER DIMENSIONAL TESTS DURING VACUUM CYCLING**

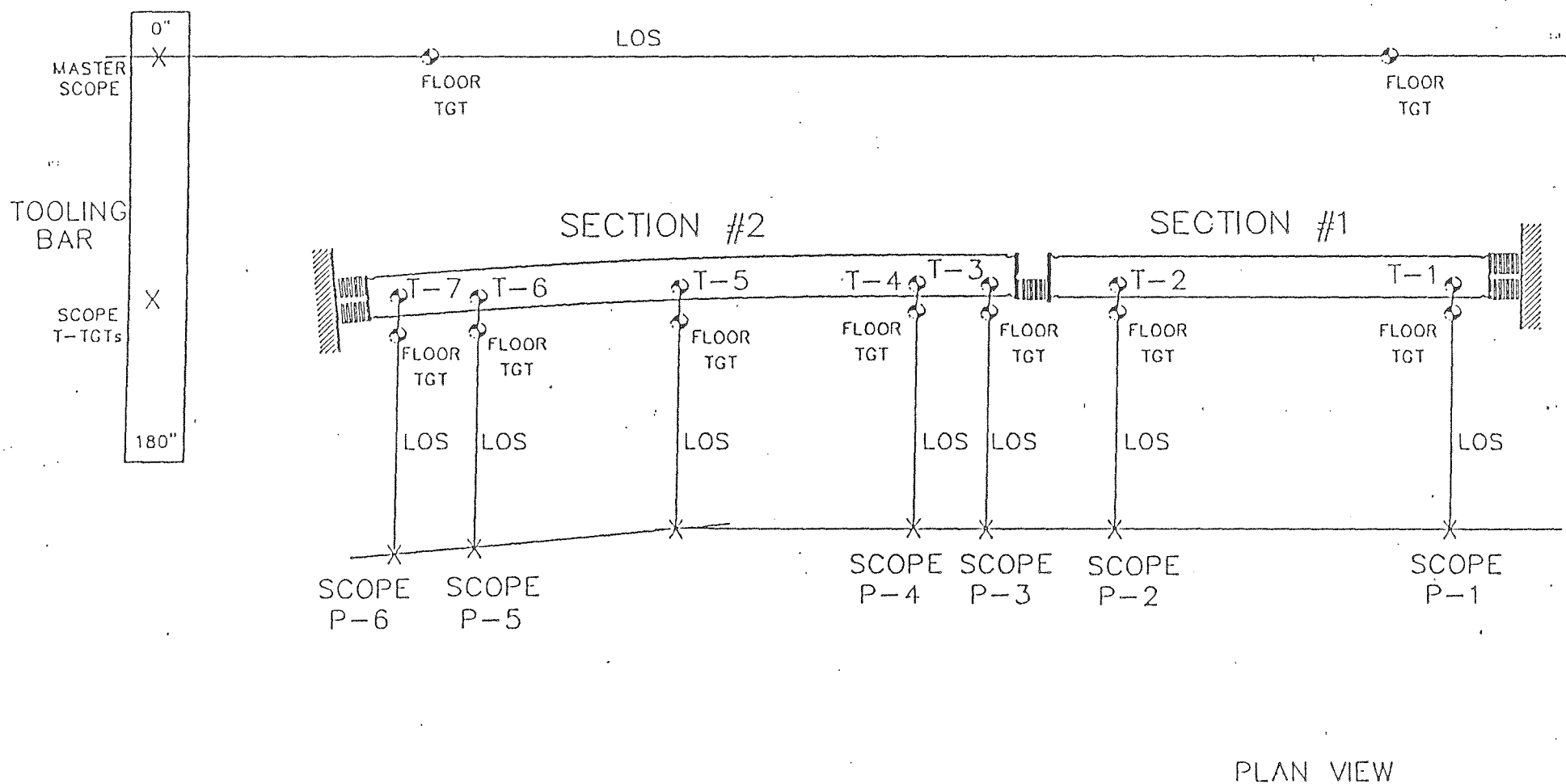
The positron beam chamber height returned to within .0015". Beam chamber total deflection height, due to vacuum versus atmosphere, averaged about .010" depending on location along the chamber.

Following the first two cycles, the gap dimensions returned to the same value within .001" for cycle #3, #4, and #5 at the three measured C locations. The first two cycles show maximum return differences of about .004" total. The total deflection due to vacuum versus atmosphere was .027" at the dipole and the sextupole area and .021" at the quadrupole area next to a flange.

These deflections duplicated earlier results, a laboratory test, of 6" length chamber sections at 150 ° C cycled from atmosphere to vacuum.

The overall results are very encouraging for chamber stability after thermal and vacuum cycling. More tests will be made for a full sector as Table I sheet indicates.

# ADVANCED PHOTON SOURCE



Plan View of Storage Ring Chamber-Support  
For the Alignment Thermal Stability Measurement Arrangement

A02297

Figure 1

# ADVANCED PHOTON SOURCE

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## Storage Ring Alignment Thermal Stability Evaluations

- Chamber mounts loosened during initial bake-cool cycles. Condition was corrected.
- Optical measurements spot checked with dial indicators.
- Variation from average measurement for 12 bake-cool cycles

<u>x</u>	<u>y</u>	<u>z</u>
T-1 +.004"/-.003"	Spot measurement indicates return to $\pm .001$ "	P-1 $\pm .001$ "
T-2 +.004"/-.002"		P-2 $\pm .001$ "
T-3 +.003"/-.002"		P-3 $\pm .001$ "
T-4 +.002"/-.002"		P-4 $\pm .001$ "
T-5 +.002"/-.002"		P-5 $\pm .001$ "
T-6 +.002"/-.002"		P-6 $\pm .001$ "
T-7 +.004"/-.003"		

- Follow on activities
  - \* Improve chamber supports.
  - \* Incorporate hot water bake.
  - \* Measure x, y, z with LVDT's and computer-driven data acquisition system.
  - \* Measure Sections 1-5 connected with photon exit port and end restraints.

Table 1